CEMSIS and Trauma Data Linkage Initiative
Emergency Medical Services Authority
Preventive Health and Health Services Block Grant (PHHSBG)
October 2020

R005 - 2020

Acknowledgments

This report was prepared by the California Emergency Medical Services Authority staff:

Victoria Lupinetti: CEMSIS Data Specialist

This report was reviewed and approved by:

Adrienne Kim: Data and QI Unit Manager

Tom McGinnis: EMS Systems Division Chief

Louis J. Bruhnke: Chief Deputy Director

If you have any questions or comments about this report, please contact:

Victoria Lupinetti

CEMSIS Data Specialist

(916) 837-9345

Victoria.lupinetti@emsa.ca.gov

This report is supported by the Centers for Disease Control and Prevention of the U.S. Department of Health and Human Services (HHS) as part of a financial assistance award totaling $1,239,475 with 100 percent funded by CDC/HHS.

The contents are those of the author and do not necessarily represent the official views of, nor an endorsement, by CDC/HHS, or the U.S. Government.

Table of Contents

Introduction

Prehospital and hospital data are unique and valuable independently. Prehospital, or Emergency Medical Services (EMS) data focus on initial signs and symptoms, vital signs, and determining whether life-saving medical intervention and transport are appropriate prior to the patient seeing a doctor. Hospital data concentrate more on patient demographics, pre-existing conditions, and outcomes of advanced medical care. Correlating EMS and hospital data for each patient can yield strong information about the whole picture: from the events leading up to the emergency/incident to post-hospital discharge. EMS and hospital personnel can implement this knowledge in future emergency and hospital care. Training, administration, and quality assurance and management will also benefit from such linked data. Ambulance dispatch and various run times can be analyzed to see where time improvements can be made and establish a more detailed record of resource utilization and tracking. EMS personnel can also benefit from gaining more insight into the outcome of each patient by allowing them to make corrections and adjustments to procedures and care-rendering in the field. Also, with this detailed database, legislators can make changes to public health policy and financial provisions to cities and counties for EMS and hospital care. There is an opportunity for expanding our knowledge that focuses on whole-patient care. Under the provisions of the Preventive Health and Health Services Block Grant (PHHSBG), this is the California EMS Authority's initial attempt to determine the feasibility of linking robust prehospital and hospital data and create a path forward for future research and policy-making decisions.

Goals for this project include:

1. Review previous reports and studies to replicate the processes and comparative results;
2. Identify a sample population where each patient has an EMS record linked to a hospital record;
3. Analyze the population through various statistics;
4. Create a table that represents the completion rate of the data elements that were selected for this study; and,
5. Summarize results and their implications for further research regarding EMS and other data linkage opportunities

Background

Accurate linkage of EMS and other patient-centered health care records is essential to identify rates and preventive measures for illness and injury, patient health outcomes, expense and resource utilization, and efficacy of pre-hospital interventions. EMS and hospital trauma data are the focus of this report. Data collected represent a period (June 2019) from a level 1 trauma hospital in Sacramento County: UC Davis Medical Center. Data was extracted from the California Emergency Medical Services Information System (CEMSIS) and Patient Trauma Registry, which are both managed by ImageTrend.

In 2014, California became the first state to implement the EMS data collection system known as CEMSIS, which is governed by the National Emergency Medical Services Information System (NEMSIS). The most recent update is NEMSIS version 3.5.0. It is a data dictionary composed of 596 data elements and is designed to be a nationwide standard for reporting EMS data. Local EMS agencies must comply with national and state data element requirements, and state agencies need only comply with national data element standards for data collection and analysis. Currently, CEMSIS data collection complies with version 3.4.

Methodology

The following information in this report is an overview of how EMS and trauma data are linked and what can be gleaned from the results and analyses. Challenges to completing the objectives included: absence of unique identifiers across multiple databases (ImageTrend Elite and Patient Registry). There may also be missing and inaccurate data entered in these databases posing significant restrictions on data matching efforts. Below is a summary of methods we used to collect, analyze, and present the linked EMS and trauma data for June 2019.

Step One

The reports for this project were from California Emergency Medical Services Information System (CEMSIS) using National Emergency Medical Services Information System (NEMSIS) data guidelines 3.4. In order to obtain the largest population possible, we did not filter the criteria too much. For example, there were emergent/non-emergent EMS records in case trauma was still documented in the Patient Registry.

We tried to find a unique identifier that would yield a high match rate for EMS and trauma records. Ideally, criteria like first and last names, dates of birth, and social security numbers are the most unique, but only dates of birth are accessible across these two databases. We were unsuccessful using the ePCR identifier because the PCR UC Davis used was used for multiple patients. Also, their PCR did not correspond to the EMS Incident Patient Care Report Number-PCR (eRecord.01). UC Davis' PCR matched to the EMS elements: Response Incident Number (eResponse.03) and Response EMS Response Number (eResponse.04). Using probabilistic research theory, we attempted to match patient records using dates of incident and dates of birth. The following are the additional criteria and data elements that were used to query our sample population.

Outline: EMS and Trauma Variables

1. Selected one trauma-level hospital in Sacramento County: UC Davis (level 1 trauma center)
2. Selected time period: June 1, 2019 through June 30, 2019
3. Selected inclusion criteria for CEMSIS transactional report:
    a. Incident date is not blank
    b. Date of Birth (DOB) is not blank
    c. Variables selected:
        i. Incident date

ii. Patient date of birth (ePatient.17)
iii. Patient age (ePatient.15)
iv. Patient gender (ePatient.13)
v. Patient race (ePatient.14)
vi. LEMSA
vii. Scene incident postal code (eScene.19)
viii. Response EMS agency (eResponse.02)
ix. Incident complaint reported by dispatch (eDispatch.01)
x. Situation primary provider impression (eSituation.11)
xi. Scene incident location type (eScene.09)
xii. Disposition EMS Transport Method (eDisposition.16)
xiii. Incident report software name (eRecord.03)
xiv. Patient medications given description (eMedications.03)
xv. Incident unit notified by dispatch date/time (eTimes.03)
xvi. Incident unit en route date/time (eTimes.05)
xvii. Incident unit arrived on scene date/time (eTimes.06)
xviii. Response time: incident unit arrived on scene – incident unit notified by dispatch
xix. Scene time: incident unit left scene minus incident unit arrived on scene
xx. Ambulance Patient Offload Time (APOT): incident destination transfer of care (eTimes.12) – incident patient arrived at destination (eTimes.11)

4. Selected inclusion criteria for the CEMSIS Trauma Patient Registry transactional report
    a. Incident date is not blank
    b. Date of Birth (DOB) is not blank
    c. Variables Selected:
        i. Incident date
        ii. Patient DOB
        iii. Patient gender
        iv. Patient race
        v. Patient ethnicity
        vi. EMS unit notified time
        vii. EMS unit at destination time
        viii. ISS calculated
        ix. ICD-10 injury description
        x. Trauma type with ICD-10 COI codes
        xi. ED/Acute care disposition
        xii. Hospital discharge disposition
        xiii. Facility name
        xiv. Transport to your facility
        xv. Interfacility transfer
    d. Yielded 2,295 EMS records for UC Davis
    e. Produced 330 Patient Registry trauma records for UC Davis

5. Created and exported the reports to Excel as ".csv" files, which were then converted into two ".xlsx" files

Step Two

Matched and queried both tables using SAS

1. Imported both files into SAS Enterprise Guide
2. Linked the tables using an inner join (only matching criteria from both are linked)
3. 193 out of 330 hospital records were mapped to EMS records (58% match rate)
4. Exported matched data query to Excel

Step Three

Cleaned and standardized data in Excel

1. Verified records for accuracy and completeness
    a. Manually entered missing ages
    b. Determined the correct gender based on best guess because it was inconsistent across three patients' records. (Used Patient Registry gender for consistency)
    c. Standardized variable names and record names for brevity
    d. Deleted duplicate columns that were unnecessary
2. Manually verified if there were more viable matching records
    a. Checked for date transpositions, incorrect or misspelled words, insertions, deletions, etc.

Results

The following is a brief list of initial assessments of the integrity of the records followed by figures and tables that represent a synopsis of the matched EMS and trauma data and analyses. 193 records were successfully matched between prehospital (EMS) and hospital (trauma) databases. This yielded a 58% match rate based on the amount of trauma records that were queried

- Two records did not identify an EMS agency, but they were still able to be matched
- 100 EMS records were blank in either eTimes.12 or eTimes.11 (or both)
- Six records had a negative time recorded meaning the time of transfer was earlier than the time documented for when the patient arrived at the destination
- Twelve records had a time of zero APOT minutes

Figure 1: Percentage of Successful and Unsuccessful Matched Records

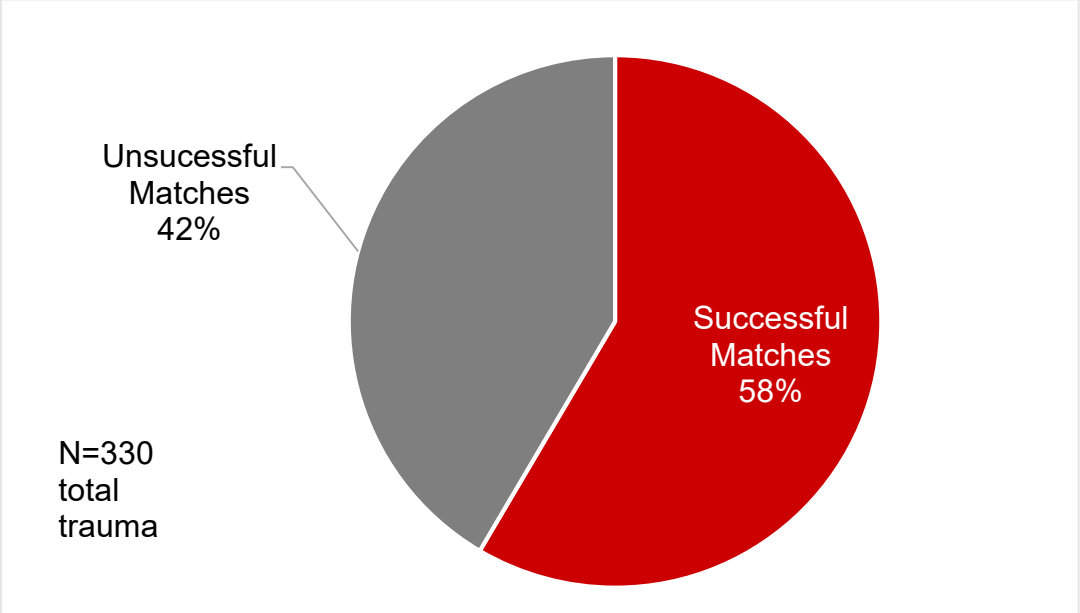
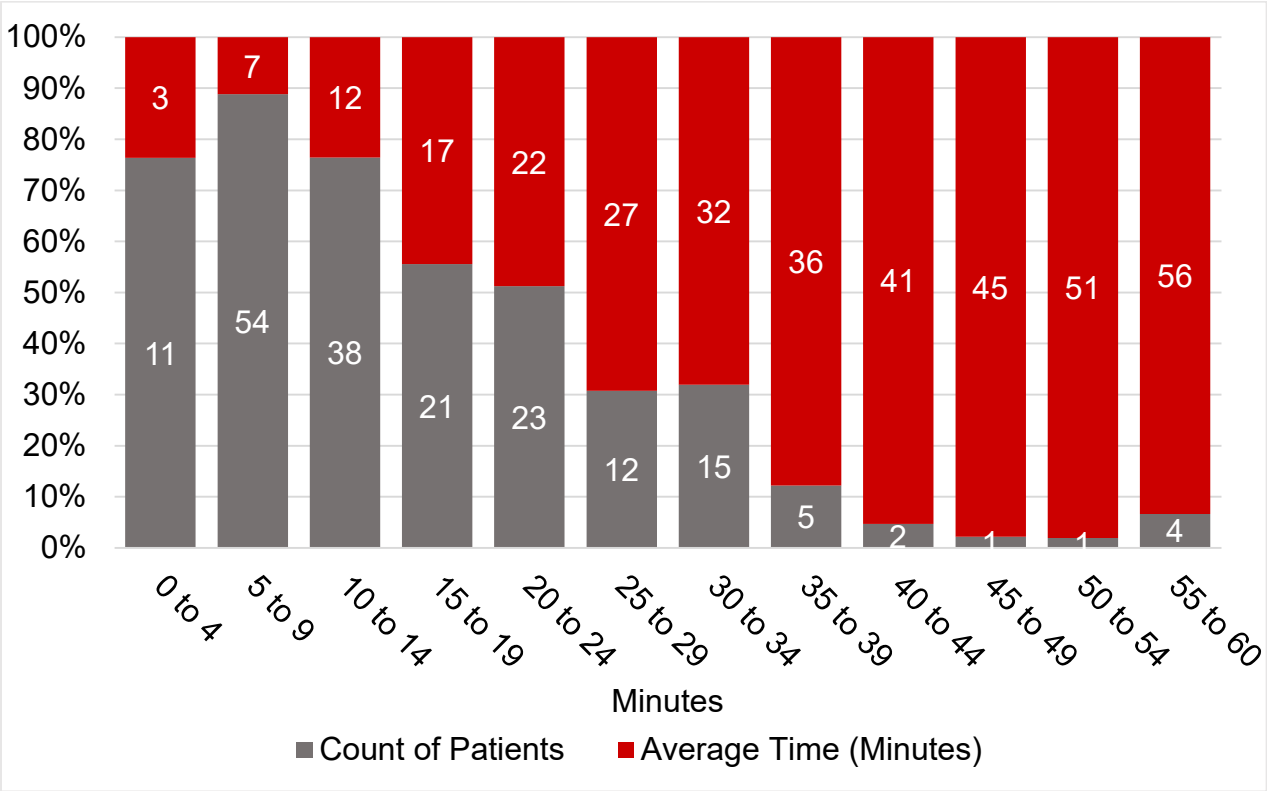
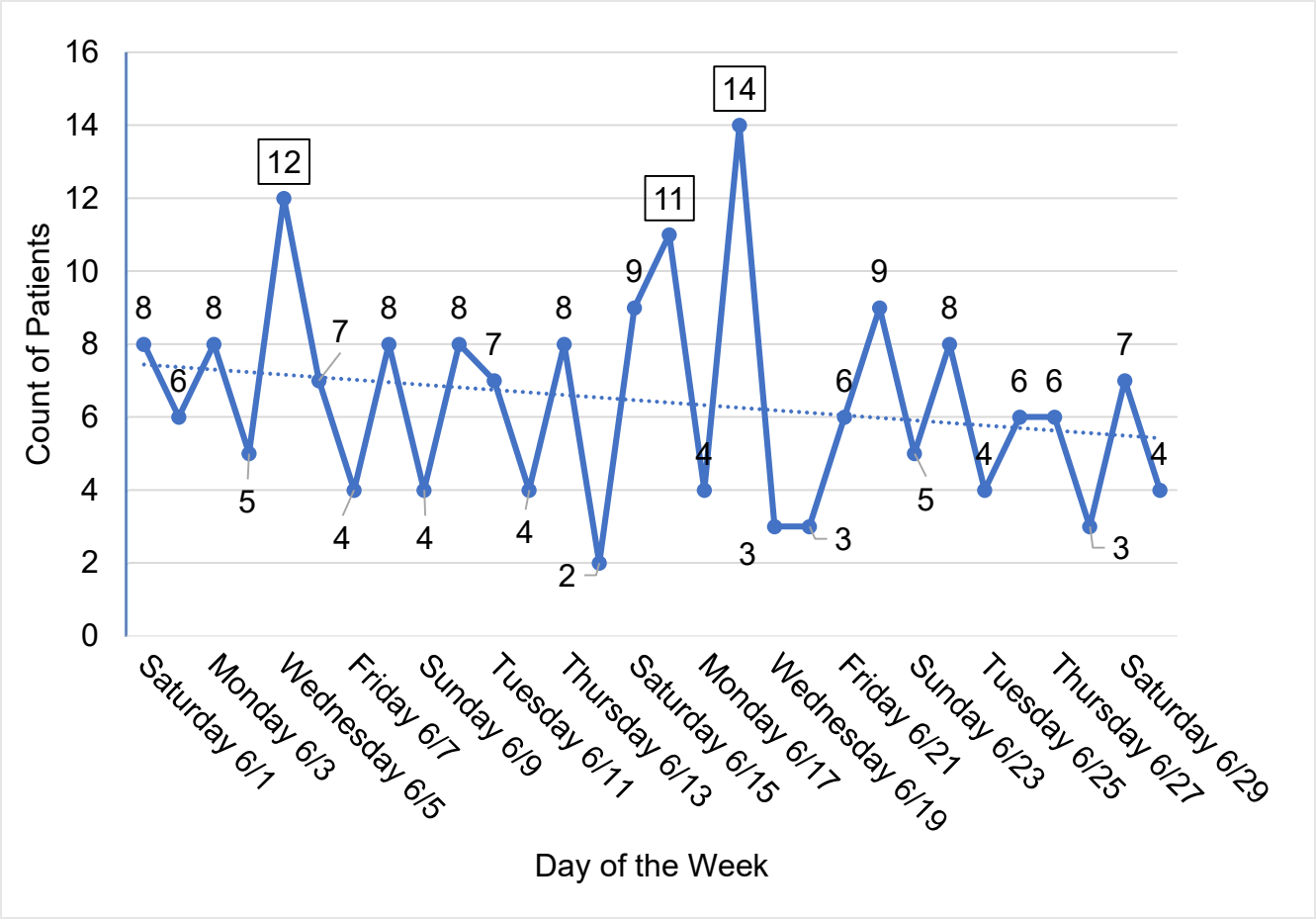


Figure 2: Count of Patients and Average On-Scene Time (Minutes)



Most patients (64%) had an average on-scene time between zero and twenty minutes, with the majority averaging an on-scene time of seven minutes. On-scene time is the time EMS arrives on scene until the EMS unit leaves the scene.

Figure 3: Count of Patients by Day of the Week



Most incidents occurred on a single Tuesday (14 patients). However, there was a higher average of incidents on weekend days (Friday-Sunday), which was about eight incidents per day.

Figure 4: Top Ten Complaints Reported by Dispatch

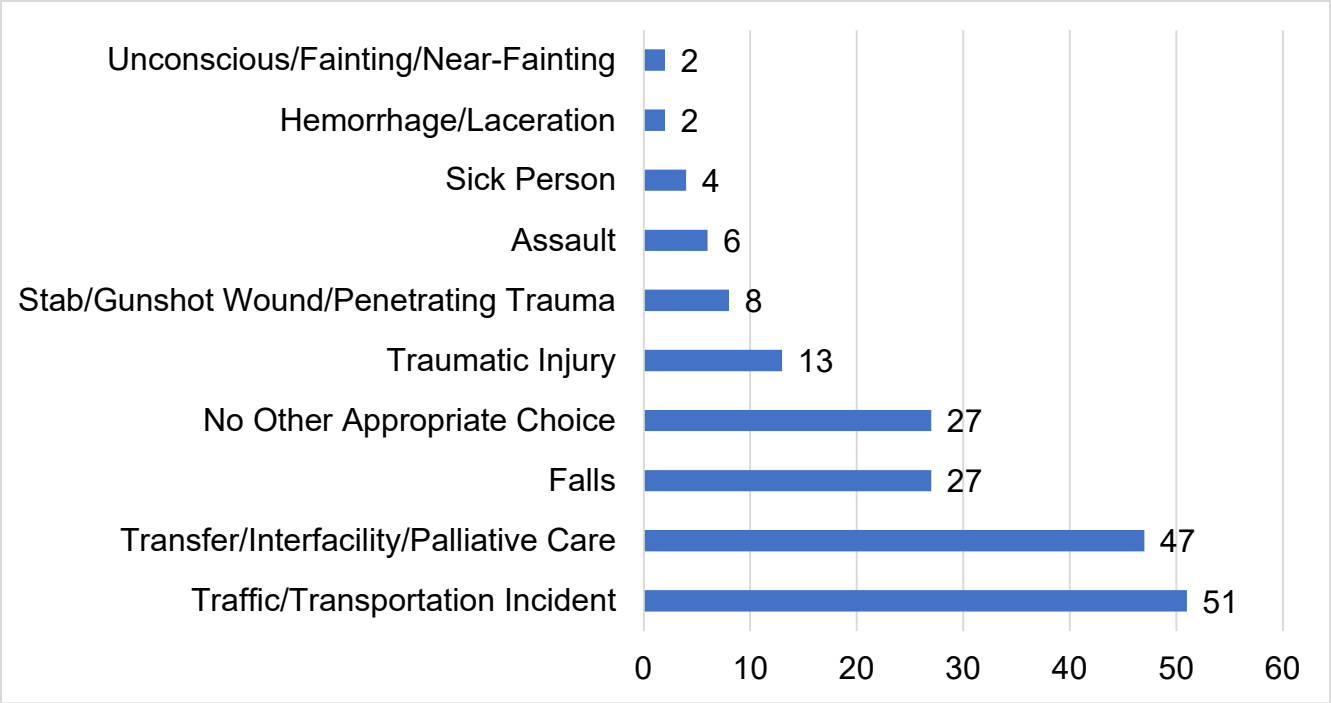


Figure 5: Top Ten Provider's Primary Impressions

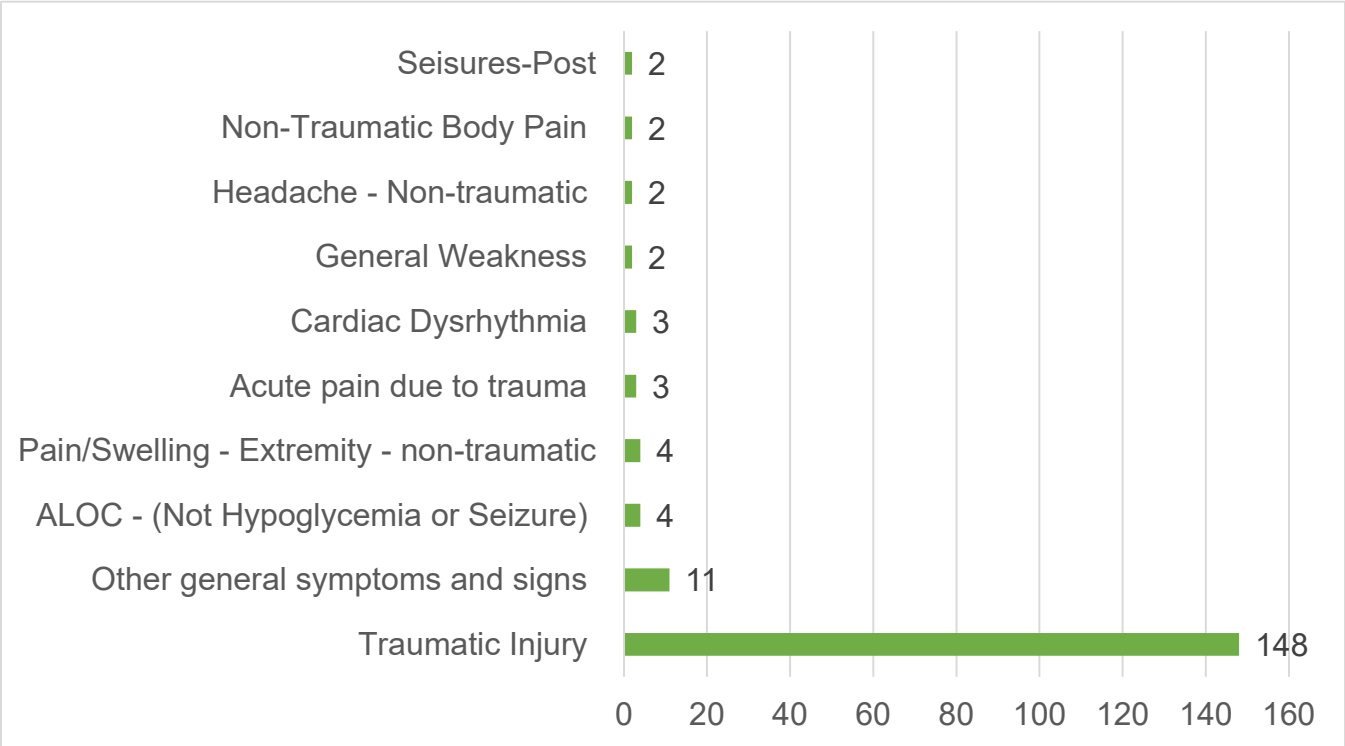


Figure 6: Interfacility Transfer

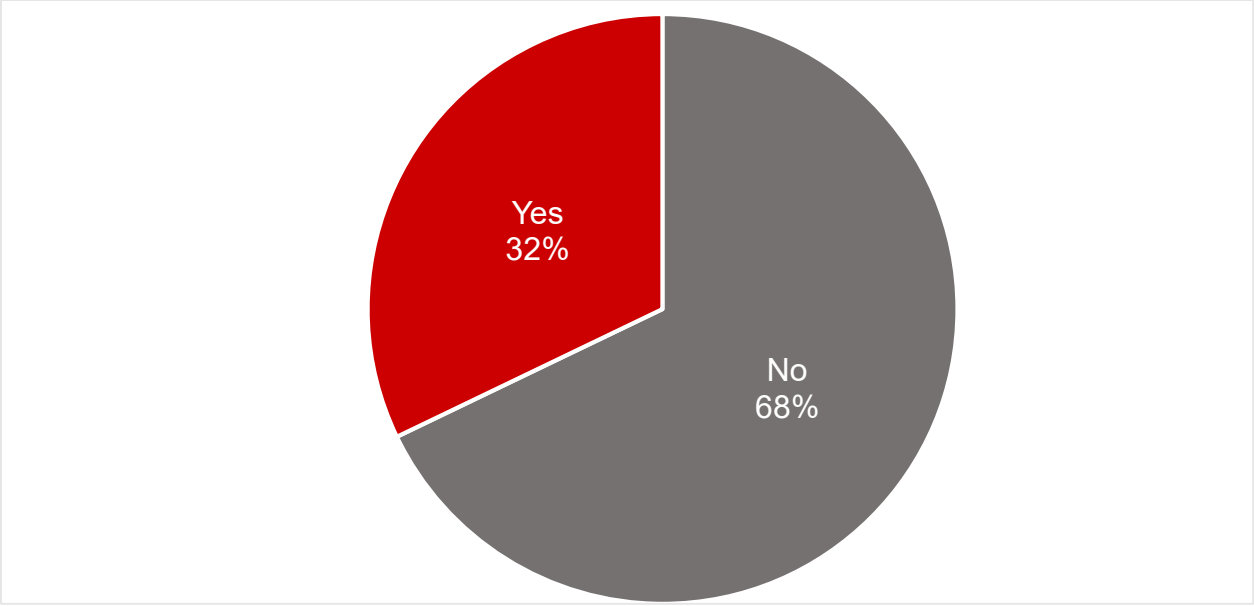


Figure 7: Trauma Type

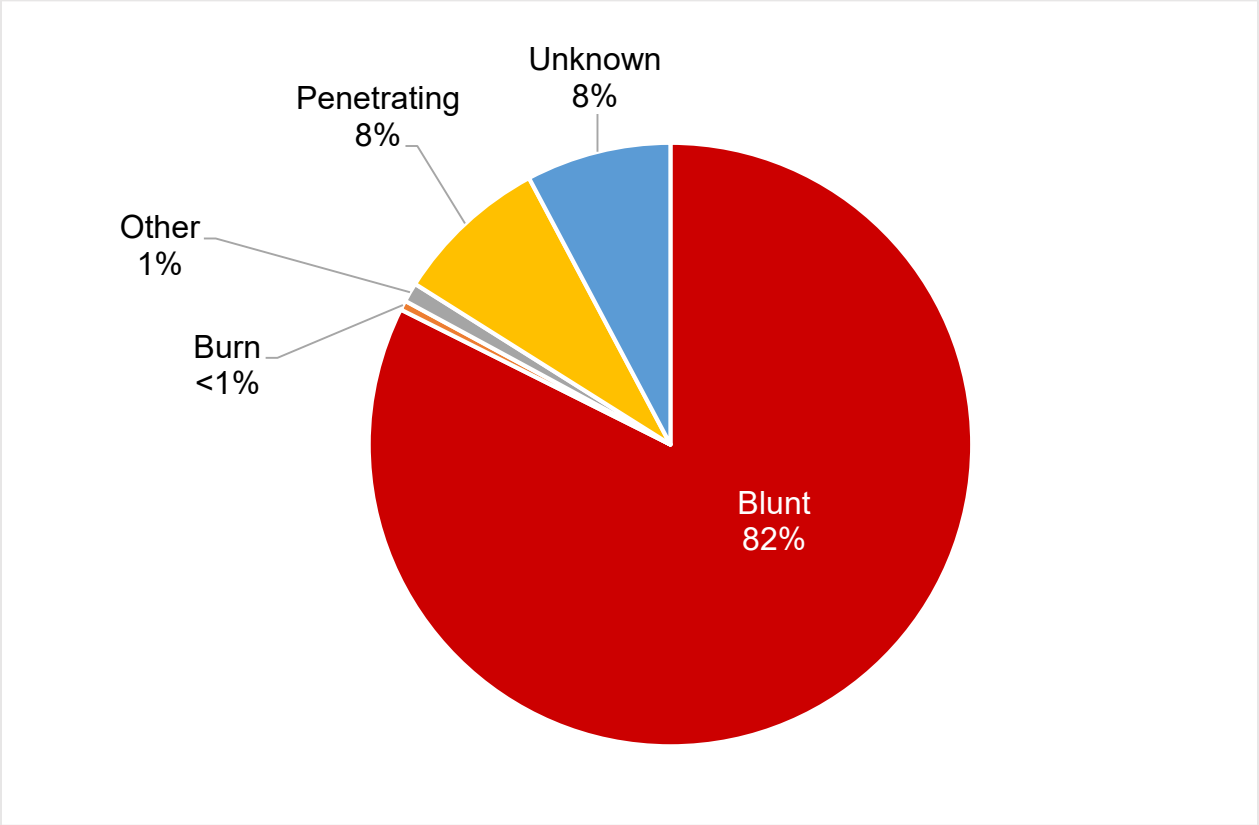


Figure 8: Top Four Causes of Injury

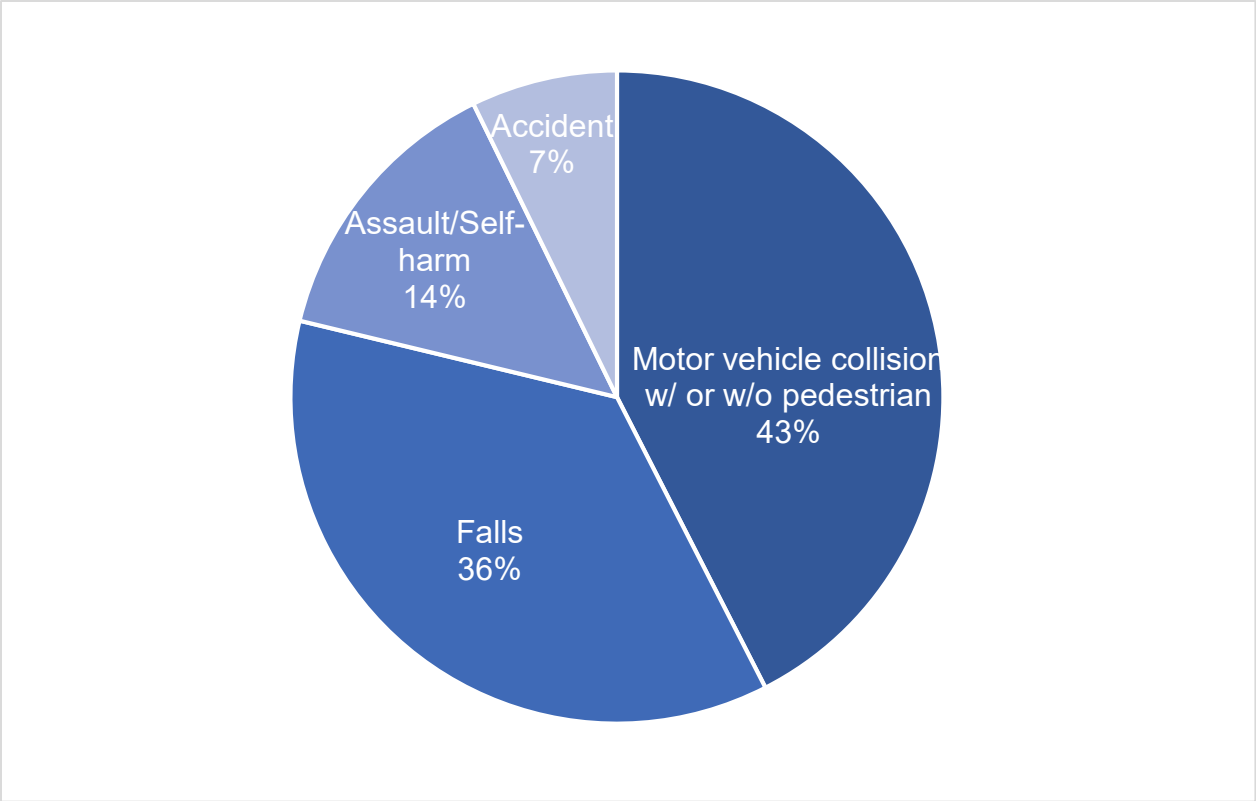
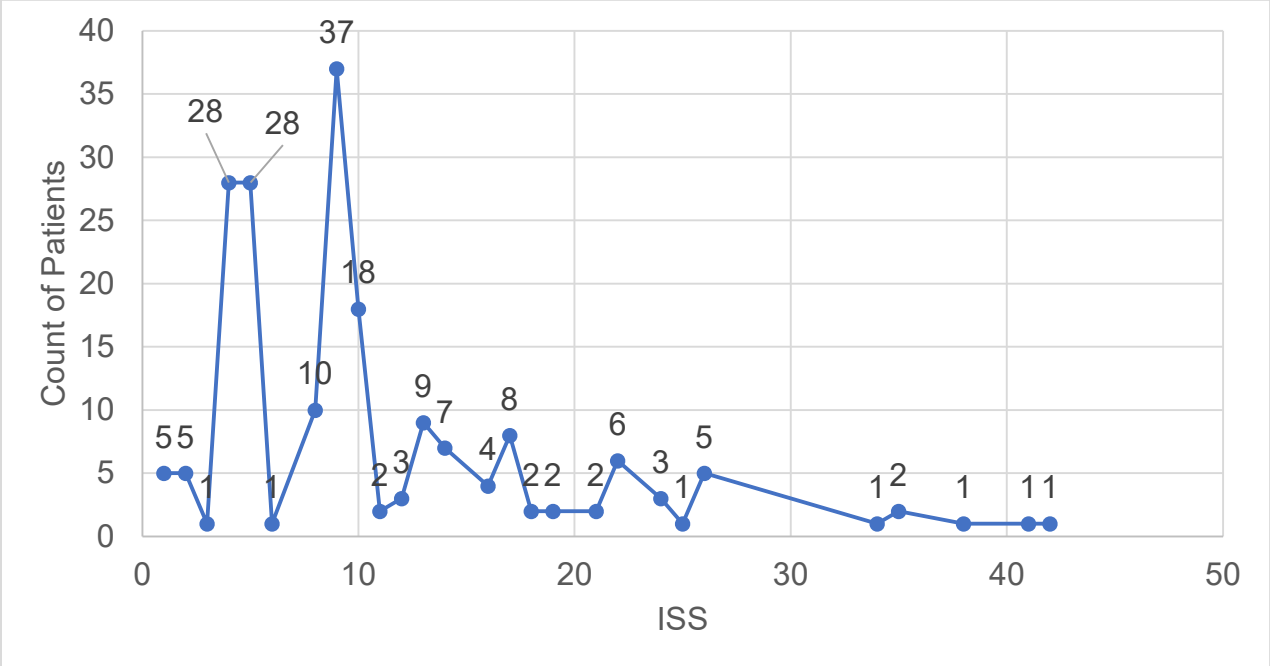


Figure 9: Injury Severity Score by Count of Patients



Injury Severity Score (ISS) is a cumulative score based on the degree of injury to six of the human body's organ systems. The higher the score the more severe the injury.

Figure 10: Hospital/Emergency Department (ED) Disposition

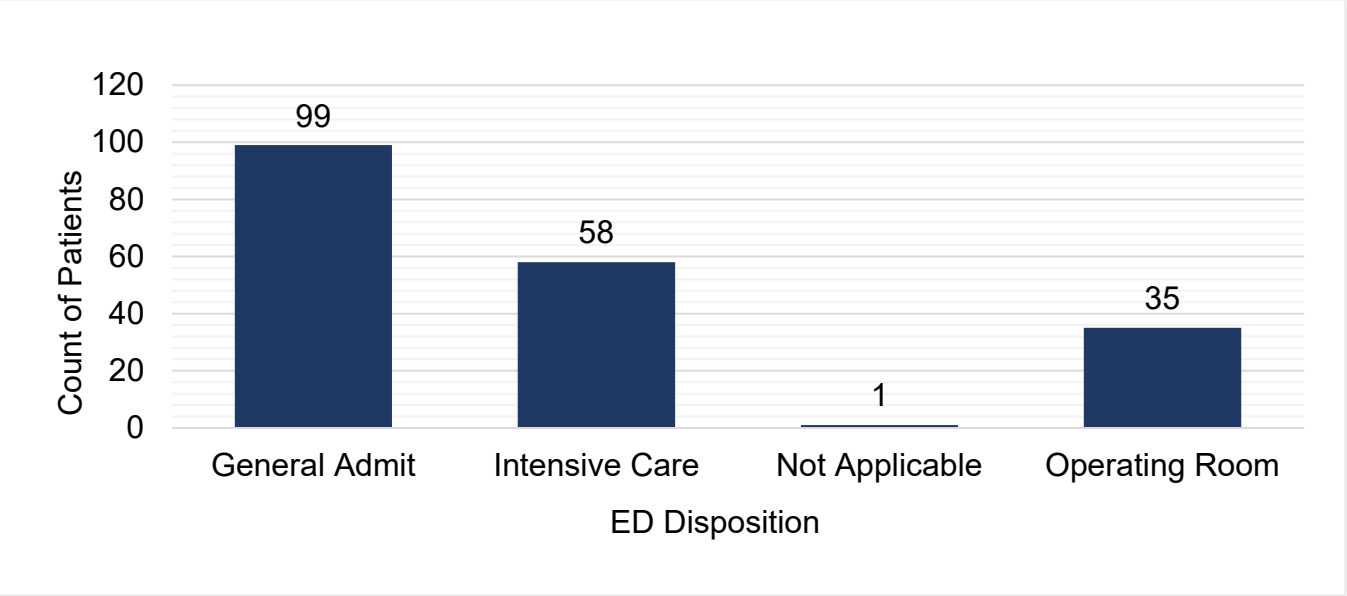
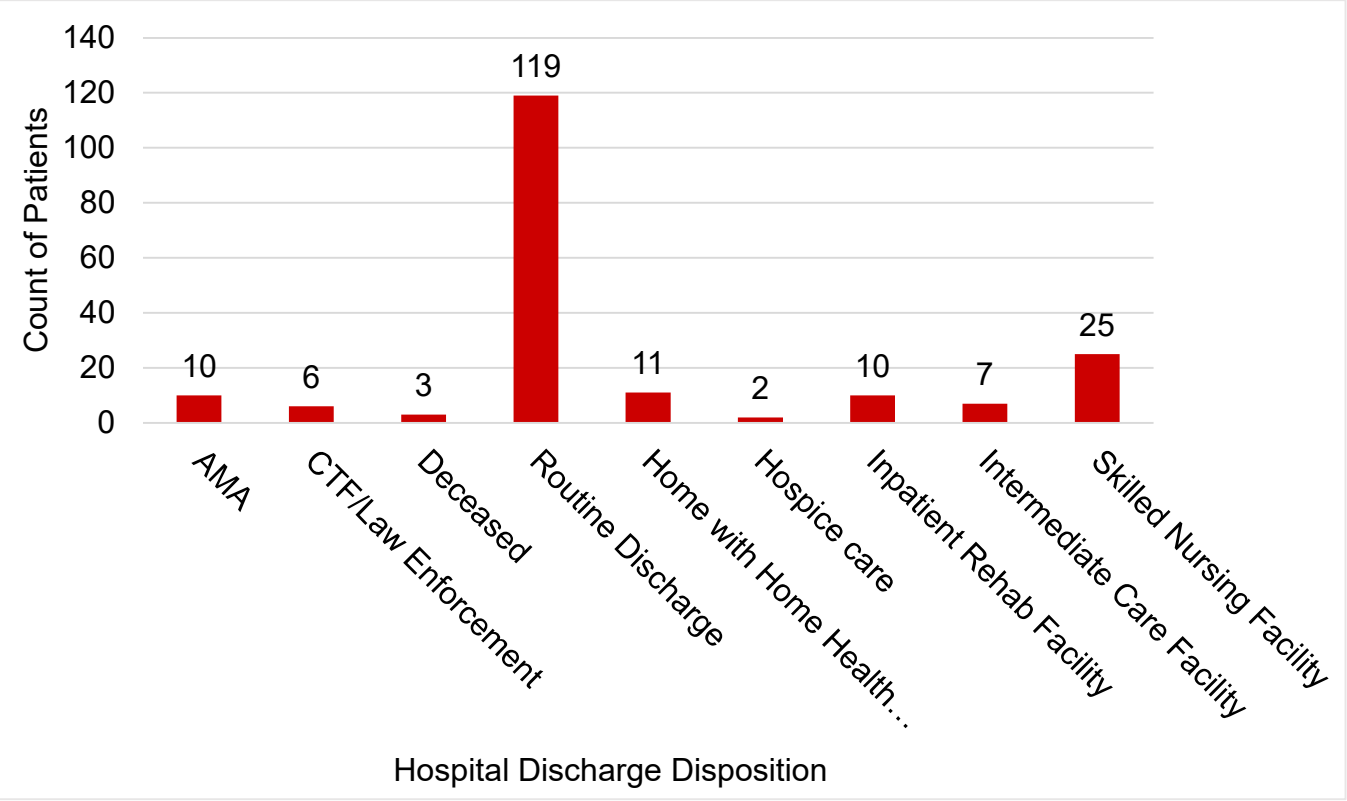
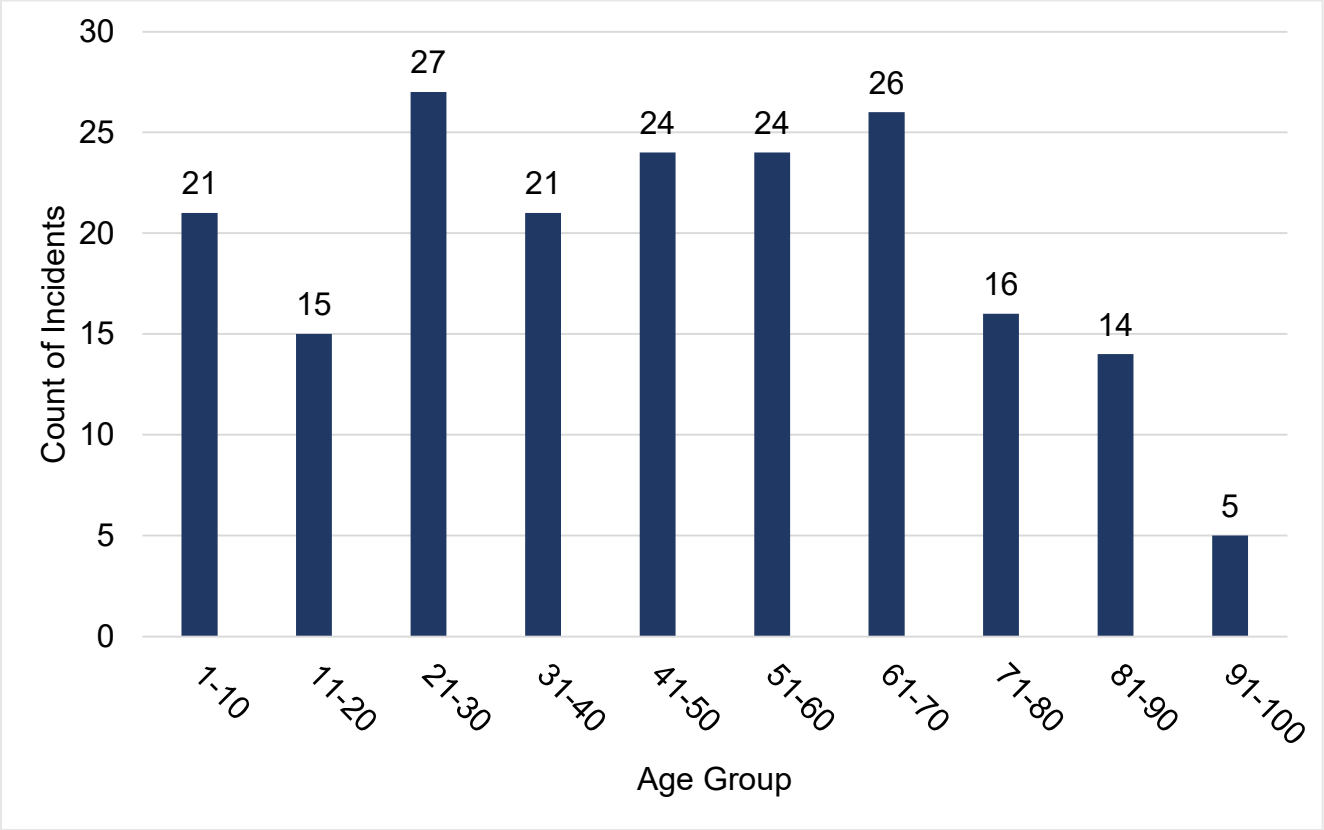


Figure 11: Hospital Discharge Disposition



Demographics

Figure 12: Count of Patients by Age Group



Average age of this sample population was 45.6 years. Most patients were between the ages of 21 and 30. The age range was 1 to 96.

Figure 13: Count of Patients by Gender

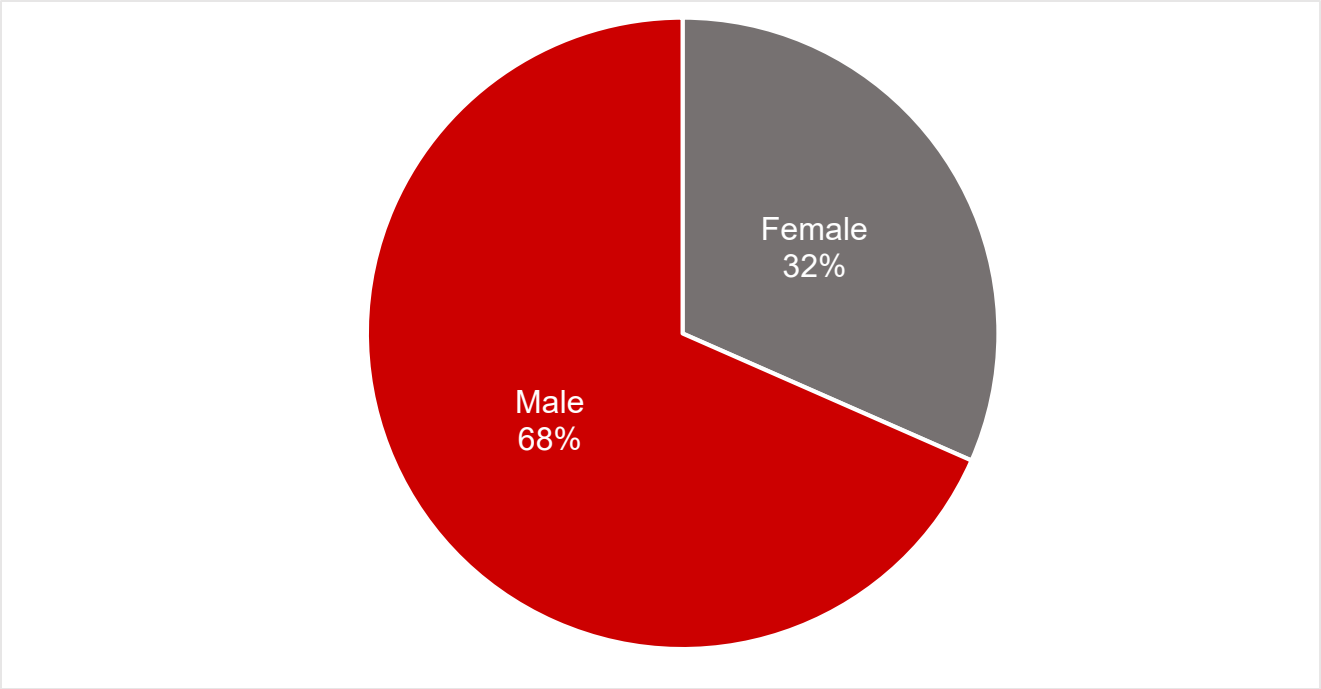
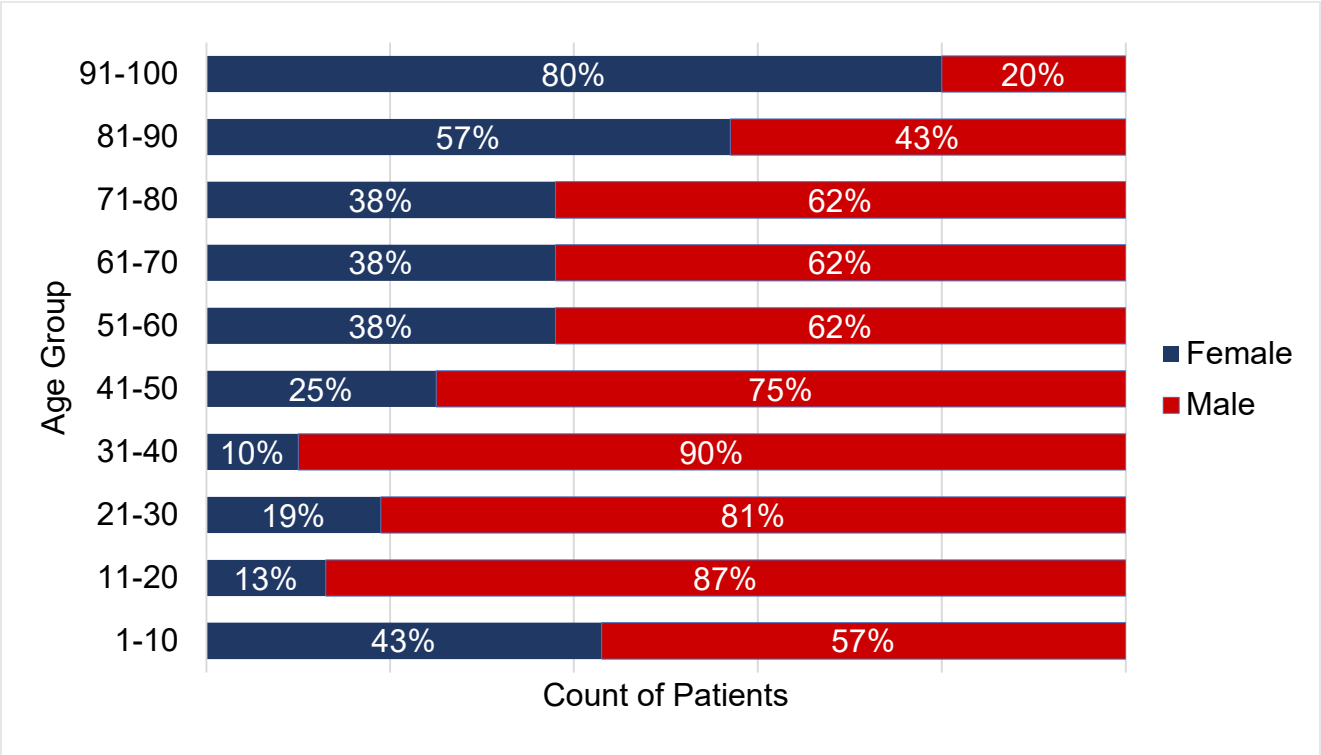


Figure 14: Count of Patients by Age Group and Gender



Males comprised 90% of the 31-40-year age group, whereas 80% of females were in the 91 to 100-year age group.

Table 1: Count of Patients by Ethnicity

Ethnicity	Count of Patients	Percent of Patients
Hispanic or Latino	40	20.7%
Not Hispanic or Latino	147	76.2%
Unknown	6	3.1%
Total	193	100.0%

Figure 15: Count of Patients by Race

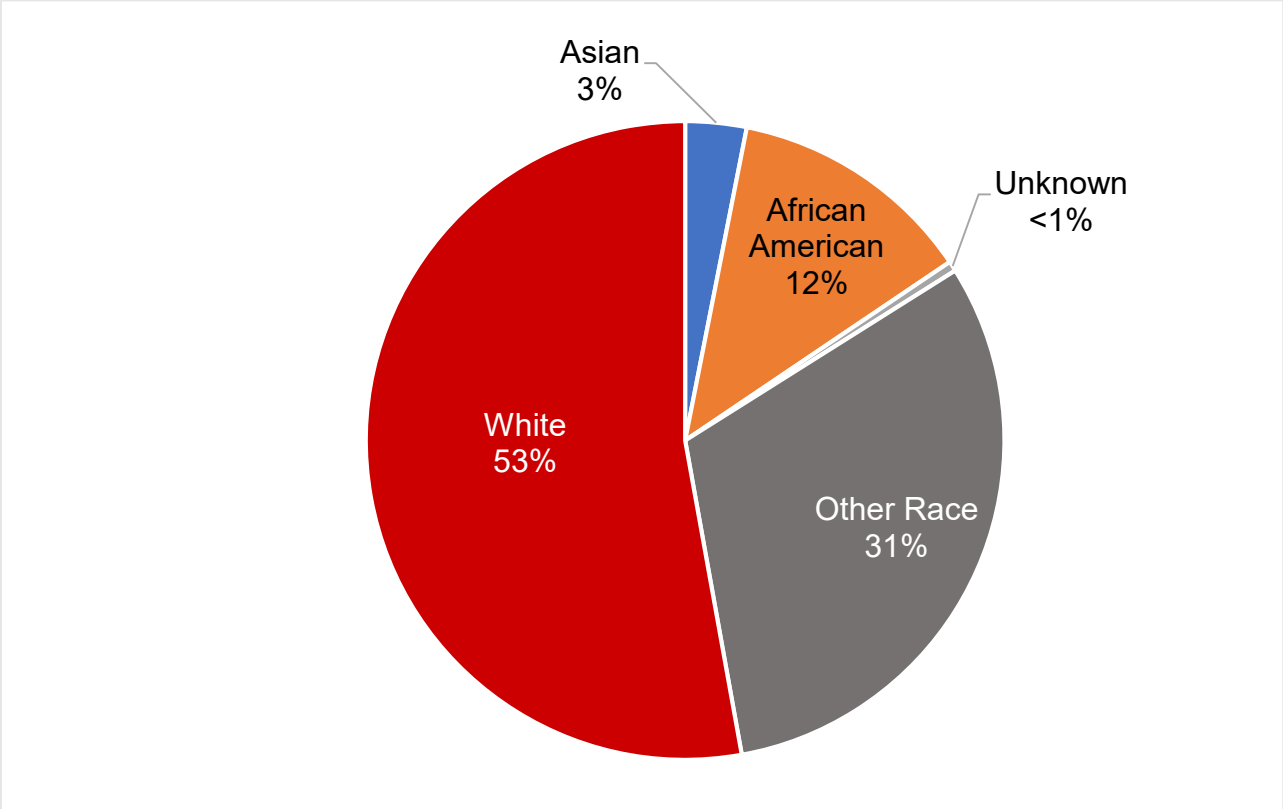
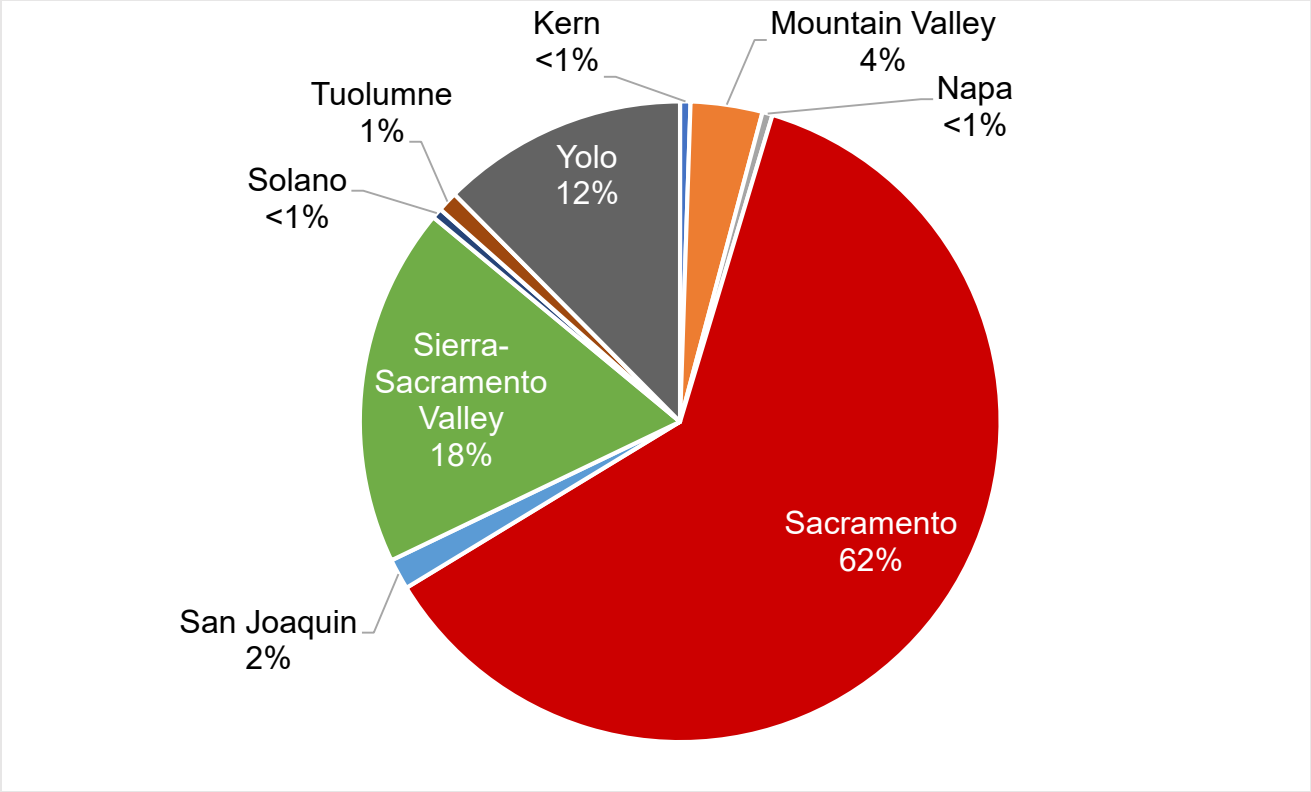


Figure 16: Count of Patients by LEMSA



Conclusion

Linking trauma and prehospital records for the same patients is warranted and effective as shown in previous studies other researchers have done. The results produced a better overall picture of each patient from the beginning of an emergency to the end results once they leave the hospital. The successful match rate (58%) of EMS and trauma patient hospital records was comparable to other studies that we identified. Several other researchers' attempts at data linkage came up short with an average of 50-70% match rates. Without distinct identifiers, like one's Social Security number, it is improbable that a 100% match rate will occur. There are also myriad technical issues with record keeping systems and data entry errors that are common. Still, a 60% match rate can produce beneficial information about a given population.

Future Directions

- Conduct a more thorough and proper probabilistic study approach in order to capture more matches and broaden the study population to other hospitals, LEMSAs, etc. throughout the state
- Determine why there are unsuccessful matches to trauma records and continue data validation
- Determine how to narrow down the criteria on the EMS side and how to get higher submission rates on medications given and run times
- Open discussions with other hospitals, LEMSAs, and government agencies in order to coordinate data sharing for further research and analysis
- Explore and present the benefits for these entities to cooperate and create outcomes data they are interested in (i.e. stroke, STEMI, MVC, etc.)
- Conduct comparative analyses based on national trends and benchmarks